

WHAT IS CLAIMED IS:

A method for performing virtual examination of an object comprising: performing at least one scan of an object with the object distended by the 3 presence of a contrast agent; 4 performing at least one scan of the object with the object relieved of the 5 contrast agent; 6 converting the scans to corresponding volume datasets comprising a 7 plurality of voxels; 8 performing image segmentation to classify the voxels of each scan into a 9 plurality of categories; 10 registering the volume datasets of each scan to a common coordinate 11 system; Πi 12 displaying at least two of the volume datasets in a substantially H.J. C. L.J. L.J. Com Arm. simultaneous manner; and 13 performing virtual navigation operations in one of the volume datasets and 14 15 having the corresponding navigation operations take place in at least one other volume 16 dataset. 1 2. The method for performing virtual examination according to claim 1, wherein the

- - at least one scan of the distended object includes a transverse scan and a coronal scan of
- the object. 3

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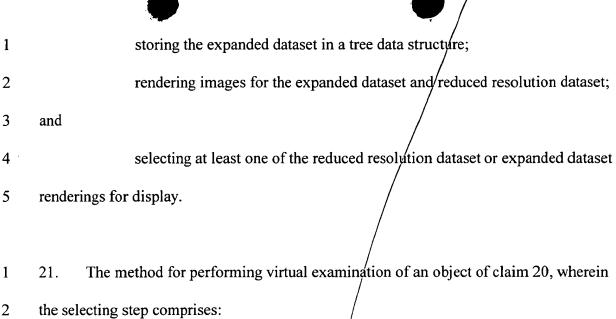


- 1 3. The method for performing virtual examination according to daim 2, wherein the
- 2 at least one scan of the relieved object includes a transverse scan and a coronal scan of the
- 3 object.
- 1 4. The method for performing virtual examination according t ϕ claim 3, wherein the
- 2 object is a bladder.
- 1 5. The method of performing virtual examination according to claim 4, wherein the
- 2 scans are computed tomography scans.
- 1 6. The method of performing virtual examination according to claim 4, wherein the
- 2 scans are ultrasound imaging scans.
- 1 7. The method of performing virtual examination according to claim 4, wherein the
- 2 scans are magnetic resonance imaging scans.
- The method of performing virtual examination according to claim 7, wherein the
- 2 contrast agent is urine.
- 1 9. The method for performing virtual examination according to claim 1, wherein the
- 2 at least one scan of the relieved object includes a transverse scan and a coronal scan of the
- 3 object.

- 1 10. The method for performing virtual examination according to claim 1, wherein the
- 2 object is a bladder.
- 1 11. The method of performing virtual examination according to claim 10, wherein the
- 2 scans are computed tomography scans.
- 1 12. The method of performing virtual examination according to claim 10, wherein the
- 2 scans are ultrasound imaging scans.
- 1 13. The method of performing virtual examination according to claim 10, wherein the
- 2 scans are magnetic resonance imaging scans
- 1 14. The method of performing virtual examination according to claim 13, wherein the
- 2 contrast agent is urine.
- 1 15. The method of performing virtual examination according to claim 1, further
- 2 comprising evaluating the at least one scan with the object distended and the at least one
- 3 scan with the object relieved to identify regions where contrast is more visible in one of
- 4 said scans and evaluating the scan with more contrast in a region of interest to determine
- 5 physiological characteristics of the object.



- 1 16. The method of performing virtual examination according to claim 15, wherein said
- 2 step of image segmentation includes classifying voxels based on local intensity vectors of
- 3 the voxels.
- 1 17. The method of performing virtual examination according to claim 16, wherein the
- 2 step of image segmentation further includes using a region growing algorithm to identify
- 3 regions of the object based on the classified voxels.
- 1 18. The method of performing virtual examination according to claim 1, further
- 2 comprising partitioning the volume image datasets into a plurality of regions related to the
- 3 coordinate system.
- 1 19. The method of performing virtual examination according to claim 18, wherein the
- 2 plurality of regions include eight regions defined in a three dimensional coordinate system.
- 1 20. A method for performing virtual examination of an object comprising:
- 2 performing an imaging scan of the object to acquire image scan data;
- 3 converting the acquired image scar data to a plurality of voxels;
- 4 interpolating between the voxels to generate an expanded dataset;
- 5 performing image segmentation to classify the voxels into a plurality of
- 6 categories;
- 7 extracting a volume of the object interior from the expanded dataset;
- 8 generating a reduced resolution dataset from the expanded dataset;



- 3 selecting the reduced resolution dataset during image interaction; and
- 4 selecting the expanded dataset rendering if no image interaction has
- 5 occurred in a predetermined time period.
- 1 22. The method for performing virtual examination of an object of claim 20, wherein
- 2 the imaging scan is a computed tomography scan
- 1 23. The method for performing virtual examination of an object of claim 20, wherein
- 2 the imaging scan is a magnetic resonance imaging scan.
- 1 24. The method for performing virtual examination of an object of claim 20, wherein
- 2 the imaging scan is an ultrasound imaging scan.

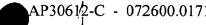
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- 1 25. The method for performing virtual examination of an object of claim 20, wherein
- 2 the object is the larynx.
- 1 26. The method for performing virtual examination of an object of claim 20, wherein
- 2 the tree structure is a binary space partition tree structure.
- 1 27. A method of performing virtual angiography comprising:
- 2 acquiring imaging scan data including at least a portion of the aorta;
- 3 converting the imaging scan data to a volume representation including a
- 4 plurality of voxels;
- segmenting the volume representation to classify the voxels into one of a
- 6 plurality of categories;
- 7 analyzing the segmented volume representation to identify voxels
- 8 indicative of at least a portion of an aneurysm in the aortic wall; and
- generating at least one closing surface around the voxels indicative of at
- least a portion of an aneurysm to estimate the contour of the aneurysm.
 - 1 28. The method of performing virtual angiography of claim 27, wherein the imaging
- 2 scan is a computed tomography scan.
- 1 29. The method of performing virtual angiography of claim 27, wherein the imaging
- 2 scan is a magnetic resonance imaging scan.

- 1 30. The method of performing virtual angiography of claim 27, wherein the
- 2 segmenting operation classifies voxels in at least the categories of blood, tissue, and
- 3 calcium deposits.
- 1 31. The method of performing virtual angiography of claim 27, further comprising
- 2 estimating the volume of the aneurysm using the generated closing surfaces.
- 1 32. The method of performing virtual angiography of claim 27, further comprising
- 2 generating a navigation path through the aortic/lymen.
- 3 33. The method of performing virtual angiography of claim 32, further comprising
- 4 estimating the length of the aneurysm based on the navigation path.
- 1 34. A method of performing virtual endoscopy of a blood vessel comprising:
- 2 acquiring imaging scap data including at least a portion of the vessel;
- 3 converting the imaging scan data to a volume representation including a
- 4 plurality of voxels;
- 5 segmenting the volume representation to classify the voxels into one of a
- 6 plurality of categories including the categories of blood, tissue, and calcium deposits; and
- generating a navigation path through the vessel.
- 1 35. The method of performing virtual endoscopy of claim 34, wherein the vessel is a
- 2 carotid artery.

- 1 36. The method of performing virtual endoscopy of claim 34, further comprising the
- 2 step of determining the diameter of the carotid artery along the navigation path to identify
- 3 regions of narrowing.
- 1 37. The method of performing virtual angiography of claim 34, wherein the imaging
- 2 scan is a computed tomography scan.
- 1 38. The method of performing virtual angiography of claim 34, wherein the imaging
- 2 scan is a magnetic resonance imaging scan.
- 1 39. A method of determining the characteristics of a stent graft using virtual
- 2 angioscopy, comprising:
- acquiring imaging scan data including at least a portion of the aorta;
- 4 converting the imaging scan data to a volume representation including a
- 5 plurality of voxels;
- segmenting the volume representation to classify the voxels into one of a
- 7 plurality of categories;
- 8 analyzing the segmented volume representation to identify voxels
- 9 indicative of at least a portion of an aneurysm in the aortic wall;
- generating at least one closing surface around the voxels indicative of at
- least a portion of an aneurysm to estimate the contour of the aneurysm;
- 12 / identifying the location of the endpoints of the aneurysm contour;





- 1 calculating the length between the endpoints of the andurysm contour to
- 2 determine the length of the stent graft; and
- calculating the diameter of the aortic lumen at the endpoints of the 3
- 4 aneurysm contour to determine the required outside diameters of the stent graft.
- 1 40. The method of determining the characteristics of a stent graft of claim 39, further
- 2 comprising determining the angle of interface of the aneurysm and normal aortic lumen to
- 3 determine an angular direction of a corresponding end of the stent graft.
- 1 41. The method of determining the characteristics of a stent graft of claim 39, further
- 2 comprising locating arterial branches proximate the aneurysm to determine a maximum
- 3 length of the stent graft.
- 1 42. The method of determining the characteristics of a stent graft of claim 41, wherein
- 2 the arterial branches proximate the aneurysm include at least one of the renal and femoral
- 3 arterial branches.
- 1 43. The method of determining the characteristics of a stent graft of claim 39, further
- comprising conducting a virtual biopsy of the aortic region proximate/the ends of the 2
- 3 aneurysm to determine the nature of the tissue at the anticipated graft interface locations.
- 1 44. A method of defining a skeleton for a three dimensional image representation of a
- 2 hollow object formed with a plurality of voxels comprising:

- 3 identifying a root voxel within the hollow object;
- 4 generating a distance map for all voxels within the hollow object, the distance map
- being formed using a 26-connected cubic plate of neighboring voxels having Euclidian
- 6 weighted distances;
- 7 identifying voxels having a local maxima in the distance map as endpoints of
- 8 branches in the hollow object; and
- 9 for each local maxima voxel, determining a shortest connected path to one of the
- 10 root voxel or a previously defined shortest path.
- 1 45. The method of defining a skeleton for a three dimensional image representation of
- 2 claim 44 further comprising performing multi-resolution data reduction to the three
- dimensional image representation to generate a reduced data set for the generating and
- 4 identifying operations.
- 1 46. The method of defining a skeleton for a three dimensional image representation of
- 2 claim 44 further comprising centralizing the shortest paths within the respective branches
- 3 of the object.
- 1 47. The method of defining a skeleton for a three dimensional image representation of
- 2 claim 44, wherein the object includes at least one blood vessel.
- 1 48. The method of defining a skeleton for a three dimensional image representation of
- 2 claim 44, wherein the object includes the airways of a lung.

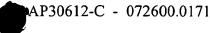


- 1 49. The method of defining a skeleton for a three dimensional image representation of
- 2 claim 44, wherein the object includes the bladder.
- 1 50. The method of defining a skeleton for a three dimensional image representation of
- 2 claim 44, wherein the object includes the spinal cord of a vertebrate animal.
- 1 51. A method of performing computed assisted diagnosis of a region of interest,
- 2 comprising:
- acquiring imaging scan data including at least a portion of the region of
- 4 interest;
- 1 converting the imaging scan data to a volume representation including a
- 2 plurality of voxels, at least a portion of the voxels representing a surface of the region of
- 3 interest; and
- 4 analyzing said portion of voxels representing a surface for at least one of a
- 5 geometric feature and a textural feature indicative of an abnormality.
- 1 52. The method of performing computed assisted diagnosis according to claim 51,
- wherein the textural feature is included in a probability density function characterizing a
- 3 correlation between two voxels of the portion of voxels.



- 1 \(\sqrt{3} \) The method of performing computed assisted diagnosis according to claim 52,
- 2 wherein the two voxels are adjacent voxels.
- 1 54. The method of performing computer assisted diagnosis according to claim 52,
- 2 wherein intensities of said portion of voxels are used to generate an estimate of the
- 3 probability density function.
- 1 55. The method of performing computer assisted diagnosis according to claim 54,
- 2 wherein a plurality of voxel intensities are used to generate a cumulating distribution
- 3 function of the region of interest and a local cumulating distribution function, and wherein
- 4 the local cumulating distribution function is compared against the context cumulating
- 5 distribution function to identify regions of abnormality.
- 1 56. The method of performing computer assisted diagnosis according to claim 55,
- wherein a distance is determined between said local cumulating distribution function and
- 3 said context cumulating distribution function, the distance providing a measure of
- 4 abnormality.
- 1 57. The method of performing computer assisted diagnosis according to claim 56,
- wherein the distance is used to assign intensity values to the voxels representing a surface
- of the region of interest and wherein said method further comprises displaying said voxels
- 4 such that variations in intensity represent regions of abnormality.





- The method of performing computer assisted diagnosis according to claim 57, 1
- wherein the region of interest includes the colon and wherein the abnormality includes 2
- 3 polyps.
- 59. 1 The method of performing computer assisted diagnosis according to claim 51,
- 2 wherein the region of interest includes the aorta and wherein the abnormality includes
- 3 abdominal aortic aneurysms.
- 60. The method of performing computer assisted diagnosis according to claim 51 1
- 2 wherein the surface is represented as a second differentiable surface where each surface
- volume unit has an associate Gauss curvature and wherein said Gauss curvatures combine 3
- 4 to form said geometric features.
- The method of performing computer assisted diagnosis according to claim 59 61. 1
- wherein a plurality of predetermined geometrical feature templates are defined and 2
- 3 wherein the geometric features of said surface are compared to said templates to determine
- a geometric feature classification. 4